Distributed Generation Improvements in Industrial Applications

U.S. Department of Energy
Joint Distributed Power and Industrial DG Quarterly Program Review

July 9 & 10, 2002
University of Wisconsin – Madison, WI

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Richard Biljetina
Energy Solutions Center Inc.

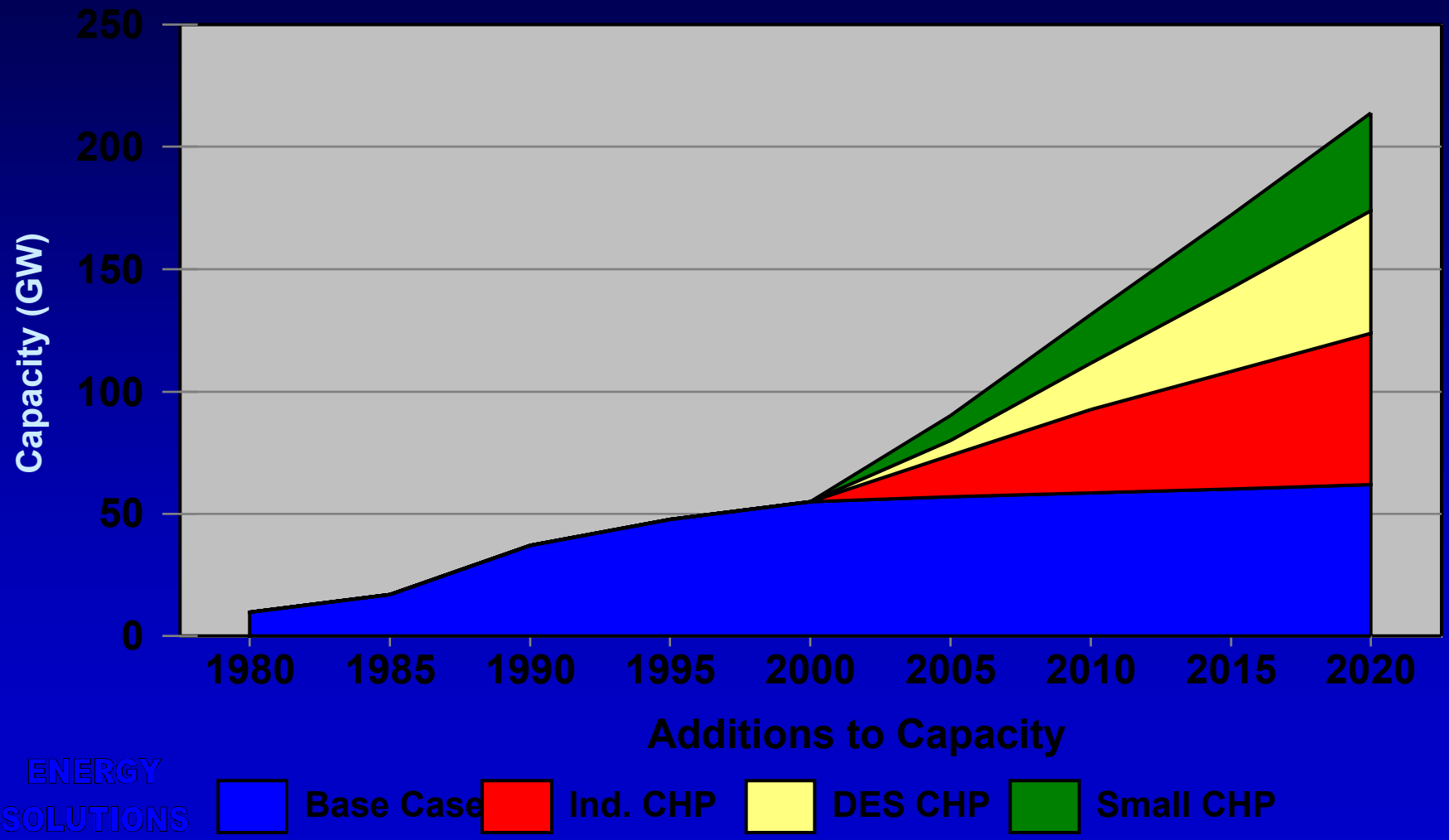
The Market for Power

- **"Energy Secretary Spencer Abraham projects a 45 % increase in generating capacity by 2020….**

….a figure that translates to the need for one new power plant weekly over the next 18 years.

Platts Energy Business & Technology, May/June 2002

150 GW or Half from CHP?



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Distributed Generation Improvements in Industrial Applications

- A joint program between *DOE DER* and the Energy Solutions Center *DG Consortium*
- DOE DER Program Mgr: Ms. Merrill Smith
- ORNL Project Manager: Ms. Patti Garland

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Project Statistics

- Contract competitively awarded to the Industrial Center in response to RFP No. 340002748
- Project initiated in December 2000
- Cost Share:

  Energy Solutions Center (ESC)* team 85% and DOE 15%

** formerly the Industrial Center*

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- NG Technology commercialization & market development organization
- Established in 1991 (spin-off from AGA)
- 501(c)6 trade association
- Consortium approach to products and services
- More details at www.energysolutionscenter.org

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ESC Membership

- 31 US and Canadian Energy Utilities
- 14 Municipal Utility Companies
- 34 Associate Members including

  AGA, GAMA, GTI, Natural Resources Canada, SwRI and Equipment Manufacturers

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Expanded ESC Mission adds Commercial Market Interests including Cooling Center Activities

Center will continue to use "Consortium" approach in support of natural gas technologies

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DG Consortium
of
Energy Utilities

Dominion Energy

Enbridge Consumers Gas

Exelon Corp. (PECO)

KeySpan Energy

Michigan Consolidated Gas

National Fuel Gas

Nicor Gas

NiSource Inc.

NW Natural

Southern Natural Gas

SoCal Gas Co.

TXU Electric and Gas

Wisconsin Gas Co.

Yankee Gas Services Co.

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Joint Program Between DER and ESC Distributed Generation Consortium

- **Phase I:** Market assessment projects an 11 GW increase for the industrial sector

  Key subcontractors: RDC and CSGI Inc.

- **Phase II:** Industrial CHP demonstrations and market transformation activities include an "Applications Manual" to help customers select more efficient, more reliable, lower cost systems

  Key subcontractors: Exergy Partners and Energy Nexus Group

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Phase I – Market Assessment

- Initiated December 2000
- Completed on time in Summer of 2001

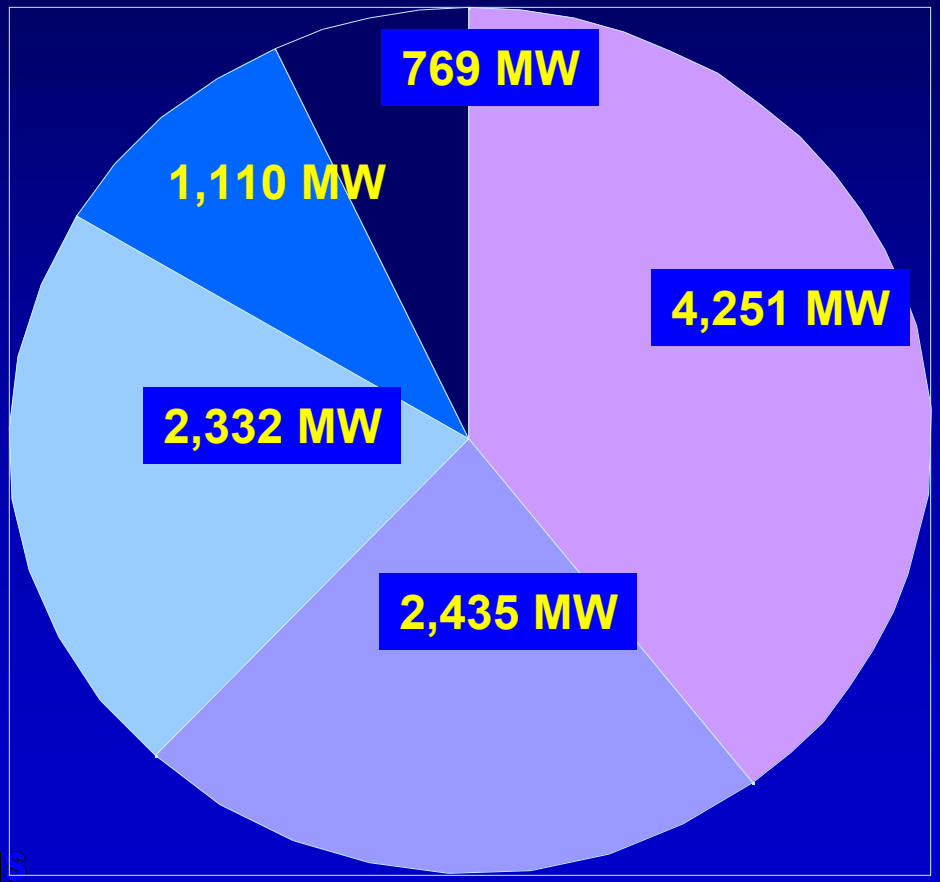
What and Where is the Market Potential for Industrial CHP Systems up to 1 MW ?

Study completed by RDC and CSGI in June 2002

Approach

- **Analyzed industrial thermal processes and determined annual energy consumptions by SIC**
- **Developed integrated DG cogeneration process schematics for *very "replicable" systems.***
- **Chose the five leading thermal processes that could be easily integrated into a cogeneration system and that offered the largest energy savings potential**

Top 5 Industrial CHP Systems 11 GW Potential



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Barriers Identified

- ✓ ***Product performance and availability****
- ✓ ***Lack of off-the-shelf integrated systems****
- ✓ ***Presence of a supporting market infrastructure****
- ✓ ***Awareness, information, and education of end users****
- ✓ ***Demonstration of successful case studies****
- ✓ **Environmental regulations**
- ✓ **Planning, zoning, and codes**
- ✓ **Tax treatment**
- ✓ **Utility rate structures**
- ✓ **Interconnection standards**

**** addressed in Phase II and Consortium Activities***

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Phase II: Demonstrations and Market Transformation

- Initiated in September, 2001
- DG Consortium membership and DOE/ORNL continue to screen candidate sites
- Two of five demonstration sites selected

use the waste heat – minimize site engineering – standardize designs

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Food Processing

Site:	**C & F Packing, Lake Villa, IL**
Product:	**Processed meat and sausages**
Cons. Utility:	**Nicor Gas**
Power Gen.:	**Two 1125 kW Waukesha Engines**
Heat Rec.:	**Boiler feed-water preheating from one engine jacket**
Operation:	**9 am to 10 pm**
Status:	**New meat processing facility commissioned 5 -02**
Comments:	**Rate response driven operation; steam used in direct contact steamers; potential to expand heat utilization**

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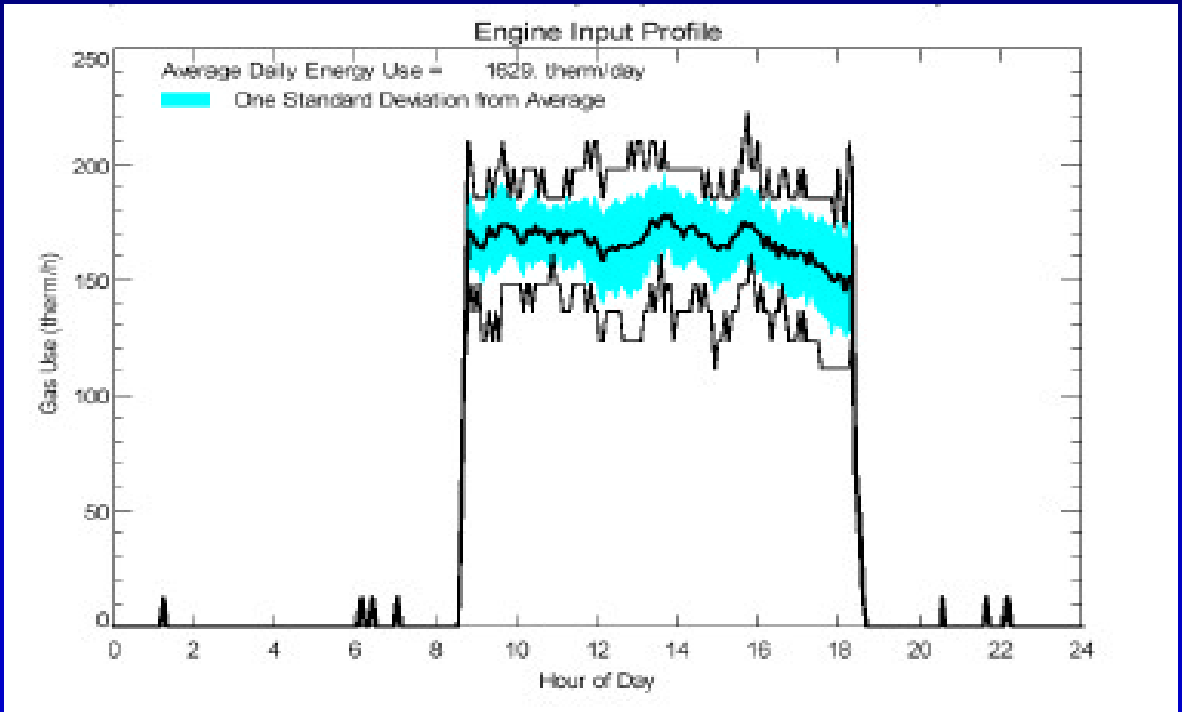
C & F Packing Data Acquisition

Agreements: Completed host site agreements in Feb. 2002

Instrumentation: Completed design and installation in May 2002

Data Collection: Begins June 2002



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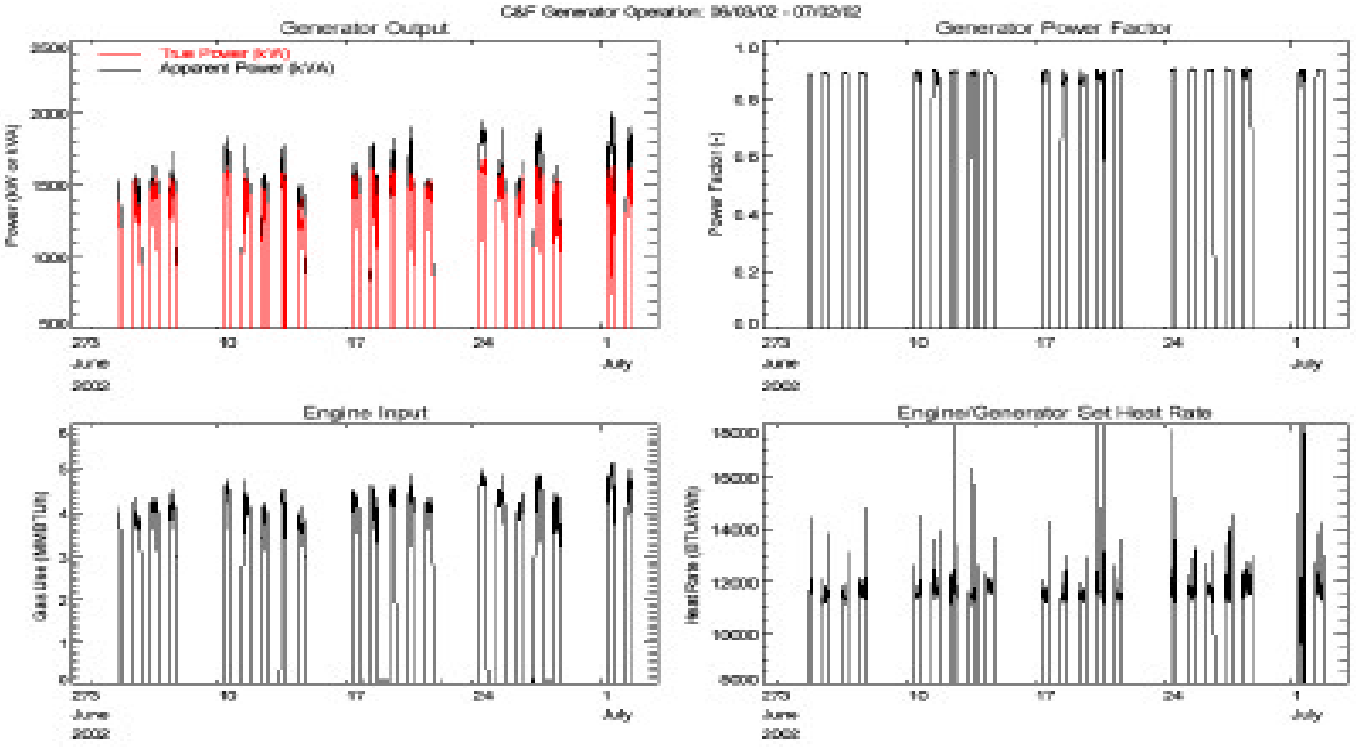
C & F Packing Data Acquisition

Engine Generator Performance

The following plot displays the operation of the generator sets observed so far in June and July. The generators reached a combined maximum output of 1,674 kW (15-minute data) on June 24 at 3:15 PM. Generator output has maintained a steady power factor of 0.90 (lagging). The generator output divided by the fuel input provides the engine heat rate, which is an indication of the generation efficiency. The observed heat rate averaged 11,823 BTU/kWh HHV (generation efficiency of 28.9 %).



C & F Packing

Metal Plating

Site:	**Faith Plating Co. in Los Angeles, CA**
Product:	**Chrome plating shop for motorcycles**
Cons. Utility:	**Southern California Gas Company**
Power Gen.:	**Four 30 kW Capstone micro-turbines**
Heat Rec.:	**Hot water for plating tank heating**
Operation:	**base loaded**
Status:	**Units placed in operation during fourth quarter 2001**
Comments:	**Customer interested in using waste heat from the Unifin heater for sludge drying for maximum heat recovery – other plating companies interested**

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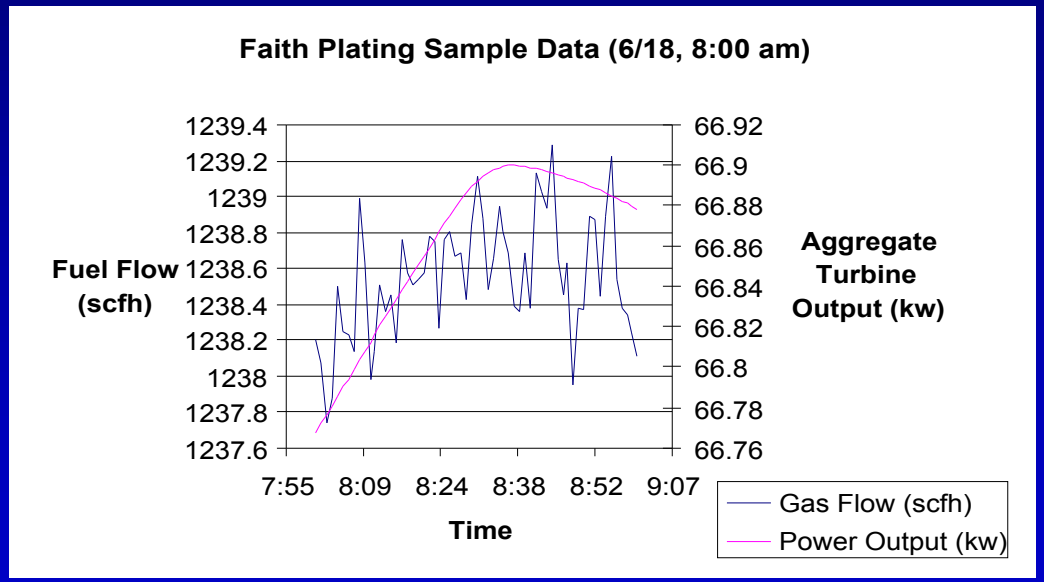
Faith Plating Data Acquisition

Agreements: Completed host site agreements in Feb. 2002

Instrumentation: Completed design and installation in May 2002

Data Collection: Begins June 2002



3 Capstones in Operation

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Demonstrations and Market Transformation

FAITH PLATING

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Applications Manual

- **Work in progress**
- **Outline:**

Chapter 1 Introduction
Chapter 2 CHP Technologies
Chapter 3 Industrial Processes and Applications to Integrate CHP Systems
Chapter 4 Installation and Design Tips
Chapter 5 Evaluating Applications
Chapter 6 Case Histories

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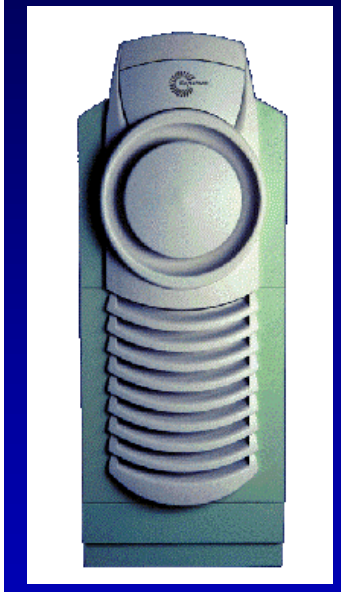
2002 Activity Plan



- **Secure site agreements and provide data plans - *completed***
- **Install data acquisition systems *(completed)* and collect data for the Nicor and SoCal sites – *in progress effective June 1, 2002***
- **Prepare case histories and initial content for the applications manual - *in progress***
- **Screen and select additional Industrial CHP demonstrations for the five key process applications - *in progress***

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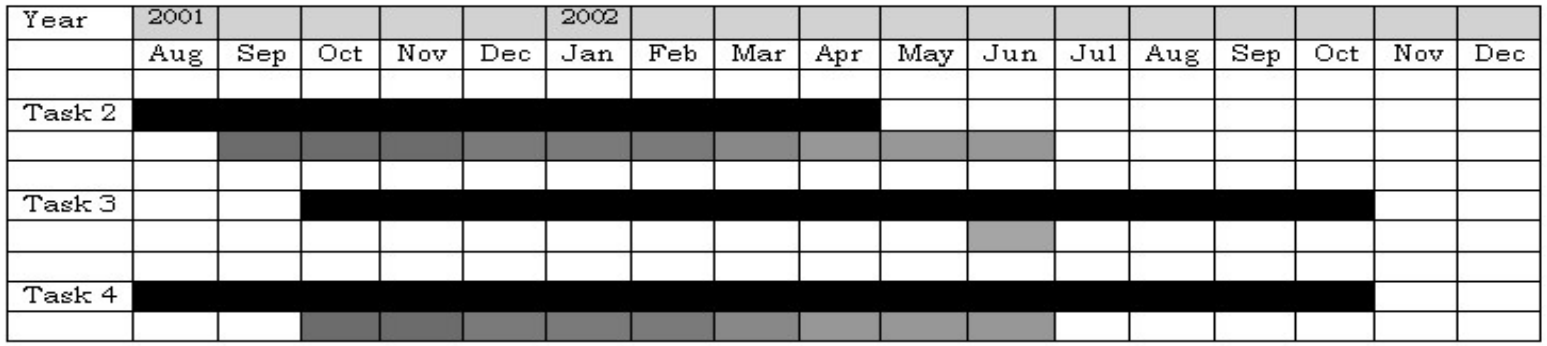
Schedule – Phase II

Schedule:



Task 2 - Agreements and Data Design
Task 3 – Data Acquisition and Case Histories
Task 4 - Support and Market Transformation

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Lessons Learned:

- **Site Agreements expected to take 3 to 6 months. Both sites required 7 months.**
- **Due to variety of equipment involved in Industrial CHP – instrument design and shake-down phase are also critical to project success. Project received benefit of skilled subcontract personnel.**
- **Open and frequent communications with all stake holders very important.**

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New Demo Sites

- **Screening additional candidate industrial CHP projects**
  - **Direct contact water heating**
  - **Indirect air/gas heating**
  - **Direct process heating**
  - **Use of exhaust gas for generating steam**

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Additional Consortium Activities

Web-Based Resource Tools

- ✓ **Website development in progress – will expand on Applications Manual content**
- ✓ **Joined "Market Street" commercial demonstration by Northwest Natural**

http://www.bpa.gov/energy/n/projects/200market/index.cfm

Screening Tools

d-gen Pro Version 3.0

- ✓ Software License obtained from GTI/Architectural Energy Corp.
- ✓ Distributed to DG Cons. Sept. 2001
- ✓ Evaluation in progress

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Sales Channel Management

Recent presentations to the ESC membership:

Micro-turbines: Ingersoll Rand

Engines: ARES Program, Waukesha

New engines: Hess

Future: Turbines, Fuel Cells

Powerworks Microturbine

Electricity: 70 kW

Heat: 100,000 to 400,000 Btu/hr

Emissions: <9 ppmv NOx & CO

Noise: 73 dbA at one meter

Efficiency: ~ 28 % recuperated

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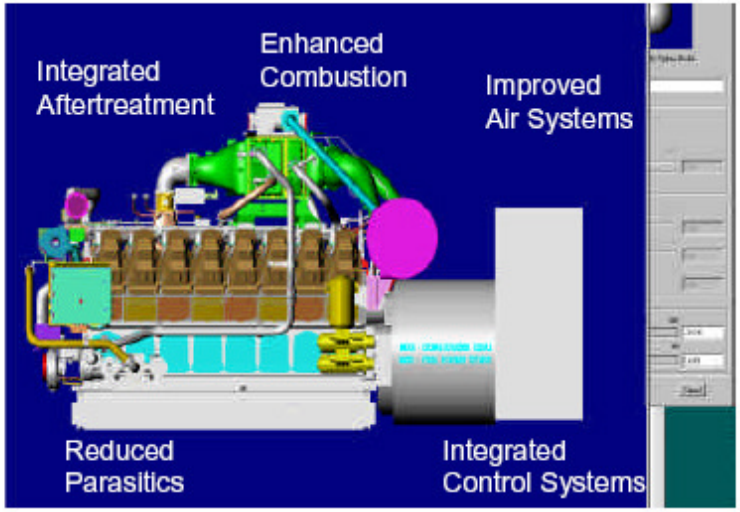
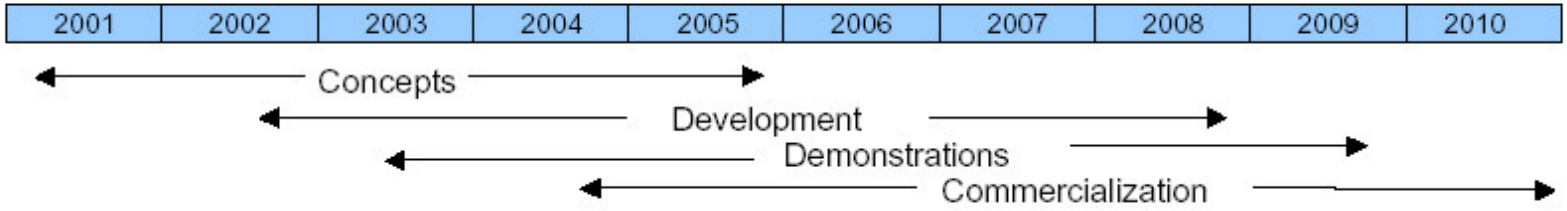
ARES PROGRAM

A multiyear cooperative agreement between the US Dept of Energy and Industry to create a 50% efficient natural gas powered reciprocating engine system with less than 0.1 Grams (9ppm) NOx emissions by the year 2010

- Multiple Phases
- Ongoing Market Verification
- Partnerships with Nat. Labs / Universities
- Pre-Commercialization Demos
- Full Commercialized Production
- Awards Announced November 2000
- Contracts Signed April 2001
- Phase 1 Complete 2004-5
- Final Phase Complete 2009-10





Source: Caterpillar TMAC presentation

Product Range

Hess manufactures a full line of packaged cogeneration systems for applications ranging from 75 kW to 4 MW.

Unit	Electricity	Heat
75	75 kW	4.5 Therms/hr
140	140 kW	6.7 Therms/hr
200	200 kW	10 Therms/hr
350	350 kW	17 Therms/hr
450	TBD	TBD

- Product range increases load matching options
- Multiple unit configurations increase reliability and flexibility

Source: Hess TMAC presentation

Appendix

Current ES Center Consortia

- Air Toxics Compliance
- Heat Treating
- Engine-driven Air Compressors
- Infrared Paper Drying
- Industrial Refrigeration
- Plastics Alliance
- Vacuum Furnace and
- ***Distributed Generation (DG)***

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ES Center DG Consortium Membership Statistics

- **Members:** *Fourteen utilities*
- **Product Champions:** *Henry Mak, SoCal Gas*
  Bob Scott, NiSource
- **Technology Lead:** *Bob Fegan, MichCon*
  Interconnect Standards
- **Center Coordinator:** *Richard Biljetina*

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Industrial CHP Support

- **DOE Office of DER & ES Center provide**
  - CHP integration and design engineering
  - data acquisition for minimum of 6 months
  - case studies and market transformation tools
- **DOE Office of DER & ES Center**
  - retain data rights
  - make public results of DG projects
- **Host site finances, owns, operates and maintains total system**

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